NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

SURFACE DRAINAGE, MAIN OR LATERAL

(Ft.)

CODE 608

DEFINITION

An open drainage ditch constructed to a designed size and grade.

PURPOSE

This practice may be applied as part of a water management system to collect and convey excess surface or subsurface water.

CONDITIONS WHERE PRACTICE APPLIES

This standard applies to ditches for conveyance of surface and subsurface drainage water primarily collected by drainage field ditches and subsurface drains.

It provides minimum drainage requirements for multiple-purpose channels that provide drainage outlets for agricultural lands. Mains or laterals having a drainage area of more than 1 square mile must meet the stability and maintenance requirements of Conservation Practice Standard 582, Open Channel. This standard does not apply to collection of water with a drainage field ditch. Conservation Practice Standard 607, Surface Drainage - Field Ditch should be used for that situation.

All lands to be drained shall be suitable for agriculture after installation of required drainage and other conservation practices.

Whether the outlet is by gravity flow or by pumping, the outlet shall be sufficient for the quantity and quality of water conveyed.

CRITERIA

The design and installation shall be based on adequate surveys and investigations. Compliance with all applicable federal, state and local laws, regulations and ordinances is required. Laws and regulations of particular concern include those involving water rights and use, water health and delivery, pollution control, property easements, wetlands, preservation of cultural resources, and endangered species. The landowner(s) shall be responsible for obtaining and complying with all applicable permits.

Drainage requirements. Mains and laterals shall be located and designed to serve as integral parts of a surface or subsurface drainage system that meets the conservation and land use needs. The degree of drainage required by the crops shall be determined and expressed in terms of drainage coefficients or depth and spacing of drains.

Capacity. The ditch capacity shall be adequate to provide for the removal of excess water, based on climatic and soil conditions and the needs of crops. The required capacity shall be obtained by determining the watershed area; the required topographic, soil, and land use information; and use of the appropriate drainage coefficients.

The required capacity of open ditches for subsurface drainage in irrigated areas shall be determined by evaluating site conditions, including irrigation water deliveries, irrigation canal or ditch losses, soil stratification and permeability, deep percolation losses, field irrigation losses, subsurface drain discharge, and quantity of surface water to be carried by the drainage ditch.

Hydraulic gradeline. The hydraulic gradeline for drainage ditch design shall be determined from control points, including elevations of significant low areas served by the ditch and hydraulic gradelines of any tributary ditches and the outlet. If control point elevations are estimated rather than computed from survey data, the hydraulic gradeline shall be no less than:

1. 1 ft. below fields that will receive normal drainage from ditches draining more than 1 mi^2.
2. 0.5 ft. for ditches draining 40 to 640 acres.
3. 0.3 ft. for ditches draining less than 40 acres.

For lands to be used only for water-tolerant crops, such as certain trees and grasses, these requirements may be modified and the hydraulic gradeline set at ground level. These provisions do not apply to channels where dikes contain flow.

The effects of hydraulic losses caused by culverts, bridges, or other obstructions in the channel section shall be evaluated.

Depth. Drainage ditches shall be designed deep enough to allow for normal siltation. Ditches that serve as outlets for subsurface drains shall be designed for a normal water surface at or below the invert of the outlet end of the drain. The normal water surface is the elevation of the usual low flow during the growing season. Where site conditions allow, the clearance between a subsurface drain invert or a field ditch invert shall be at least 1 ft. to account for sediment accumulation in the main or lateral.

Cross section. The design ditch cross section shall be set below the design hydraulic gradeline and shall meet the combined requirements of capacity, limiting velocity, depth, side slopes, bottom width, and, if needed, allowances for initial sedimentation. Side slopes shall be stable, shall meet maintenance requirements, and shall be designed on the basis of on-site conditions.

The drainage guide or other local information shall be used to determine side slope limits for specific soils and/or geologic materials. If such information is not available, the design side slopes in the main or lateral shall not be steeper than those shown in Engineering Field Handbook (EFH) Part 650, Chapter 14, Section 650.1412 (d). Stability during rapid drawdown conditions must be considered.

Velocity. The maximum permissible design velocity shall be based on site conditions and shall insure stability of the ditch bottom and side slopes. Design velocities shall not be less than 1.4 ft/s to avoid excessive sedimentation.

The velocity for newly constructed channels with drainage areas in excess of 1 square mile shall meet the stability requirements specified for Conservation Practice Standard 582, Open Channel.

Capacity design. Manning's equation shall be used in determining the design velocity, and the value of *n* (roughness coefficient) shall be based on alignment, probable vegetative growth expected with normal maintenance, other roughness factors, and the hydraulic radius. Unless special site studies are available to justify other values, the values of *n* in the EFH Part 650, Chapter 14, Section 650.1412 (d) or the local drainage guide, based on the hydraulic radius of the channel and assuming an aged channel with good maintenance and good alignment, shall be used in solving Manning's equation for mains and laterals when determining the design for required capacity.

Berms and spoil banks. Adequate berms at a safe distance from the drain shall be provided and shaped, as required, to provide access for maintenance equipment, to eliminate the need for moving spoil banks in future operations, to provide for work areas and facilitate spoil bank spreading, to prevent excavated material from washing or rolling back into ditches, and to lessen sloughing of ditchbanks caused by heavy loads too near the edge of the ditchbanks. The spoil shall be spread as soon as practical. Minimum berm widths shall be those recommended in EFH Part 650, Chapter 14, Section 650.1412 (d) or the local drainage guide, except where the spoil is spread according to the Conservation Practice Standard 572, Spoil Spreading.

Where spoil material is to be placed in banks along the ditch rather than spread over

adjacent fields, the spoil banks shall have stable side slopes. Provision must be made to channel water through the spoil bank and into the ditch without causing serious erosion.

Related structures and ditch protection. Mains and laterals shall be protected against erosion where surface water or shallow ditches enter deeper ditches. This may be achieved through the use of chutes, drop structures, pipe drops, other suitable structures or grassed waterway, critical area seeding, filter strips, or specially graded channel entrances.

Grade control structures, bank protection, or other suitable measures shall be used if necessary to reduce velocities and control erosion.

Culverts and bridges shall have sufficient hydraulic capacity and depth to satisfy drainage needs and to minimize obstruction to flow.

Capacities of pipe or drop structures shall be determined by use of the applicable drainage coefficients. The “island-type” method of construction shall be used to protect the structure from washout by flows exceeding design capacity.

Each structure for an open ditch system shall be designed according to NRCS standards for the kind of structure and type of construction used.

Channel vegetation. Vegetation shall be established according to Conservation Practice Standard 322, Channel Bank Vegetation.

CONSIDERATIONS

When planning this practice, consider:

- Possible damages above or below the point of discharge that might involve legal actions or other offsite impacts.
- Potential impacts on wetlands.
- Impact on cultural resources.
- Use of riparian buffers, filter strips and fencing.
- Potential water quality impacts for soluble pollutants and attached sediment pollutants.

PLANS AND SPECIFICATIONS

Plans and specifications for constructing mains or laterals shall be in keeping with this standard and shall describe the requirements for constructing the practice to achieve its intended purpose.

OPERATION AND MAINTENANCE

A site-specific operation and maintenance plan shall be provided to and reviewed with the landowner(s) before the practice is installed. The plan shall adequately guide the landowner(s) in the routine maintenance and operational needs of the surface main or lateral. The plan shall also include guidance on periodic inspections and post-storm inspections to detect and minimize damage to the drain.

Requirements for operating and maintaining all drainage mains and laterals having drainage areas in excess of 1 square mile shall be according to Conservation Practice Standard 582, Open Channel.

REFERENCES

NRCS, Engineering Field Handbook, NEH Part 650.

NRCS, National Engineering Handbook, NEH Part 624, Drainage.

NRCS, Technical Reference (TR) 25, Design of Open Channels.